

Three New Records of Antipatharia (Anthozoa: Ceriantipatharia) from Korea

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ABSTRACT

The antipatharians in Korea were known with three species and two genera belonging to family Antipathidae. In the present study, three species, *Antipathes densa*, *A. grandiflora*, and *A. dubia*, have been newly recorded to Korean antipatharian fauna with the samples collected from Jeju-do during the period from 2003 to 2005. The description was mainly based on the habitat, the branching mode of corallums, the size and arrangement of polyps and spines on the axis, and also the types of cnidae. They had three kinds of cnidae: spirocyst, basitrich, and microbasic p-mastigophore. Spirocysts and basitrichs were distributed at tentacles and microbasic p-mastigophores were mainly at septal filaments.

Key words: taxonomy, Antipatharia, Anthozoa, Korea

INTRODUCTION

The antipatharians are colonial anthozoans characterized by a black, spiny and keratinlike axis. They are harvested commercially for jewelry and an ancient belief that wearing pieces of its skeleton benefits the health, and nowadays, most of them are legally protected by CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and the Extinct, Crisis and Protective Species of Korea.

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On the Korean antipatharians, Kamita and Sato (1941) recorded only one species, *Antipathes japonica*, and Song (1987) reported two species, *Antipathes lata* and *Cirripathes anguina*. In the present study, three species belonging to one genus and one family are turned out to be new to Korean fauna.

The cnidae which are used as an important key of classification have been provided valuable sources of information on their type and distribution for defining the relationships to anthozoans.

While spirocysts between two major types of cnidae, nematocysts and spirocysts, analyzed by Weill (1934)'s system are limited to the zoantharians of Anthozoa, all cnidarians possess various types of nematocysts, such as artrich, basitrich, holotrich, microbasic mastigophore, microbasic amastigophore and others. For the systematic study of antipatharians, we especially described the types and distribution of cnidae in this paper.

MATERIALS AND METHODS

For the taxonomic study of antipatharians, specimens were collected from the rocky areas of Jeju-do by SCUBA diving during the period from 2003 to 2005. Samples were fixed in 70-80% alcohol after anesthetization with menthol.

The identification was done on the base of morphological characters with light and stereo microscopes. Their examination was especially emphasized on the growth form and branching mode of corallums, the size and arrangement of polyps and spines on the axis and also the types of cnidae. To examine the size and distribution of cnidae, they were prepared by squashing a bit of tissue on a drop of phenol-glycerol solution (Song and Cha, 2004) and measured with ocular micrometer under $\times 1,000$ of light microscope (Olympus BH2) attached with a digital camera (Olympus 5060WZ).

RESULTS

Order Antipatharia Milne Edwards and Haime, 1857

Family Antipathidae Verrill, 1865

Subfamily Antipathinae Brook, 1889

Section Ramosae Brook, 1889

Genus *Antipathes* Pallas, 1766

Key to the species of genus *Antipathes*

1. Branches anastomose *Antipathes dubia*
 Branches not anastomose 2
2. Corallum one plane *A. densa*
 Corallum multi-planes *A. grandiflora*

****Antipathes densa* Silberfeld, 1909 (Figs. 1-3, Table 1)**

Antipathes densa Silberfeld, 1909, p. 23, figs. 1, 3; Utinomi, 1965, p. 300, text-fig. 467
Opresko, 1974, p. 47; Okutani, 1999, p. 46, text-fig. 2; Uchida and Soyama, 2001, p. 131,
text-figs. 1, 2.

Antipathes densus: Utinomi, 1976, p. 27, pl. 14, fig. 3.

Material examined. 1 ind. Munseom, 14 Dec. 2003 (D. B. Ko); 1 ind. Munseom, 10 Apr. 2004
(S. J. Hwang), 34 m deep; 1 ind. Seogwipo, 13 May 2005 (S. H. Kim); 1 ind. Seogwipo, 6 Jun.
2005 (S. H. Kim).

Description. Colony about 46 cm high, 38 cm wide and 2.2×2.5 cm in diameter at basal part of
stem of largest colony. Longest stem about 37 cm long and 3 mm in diameter at its base. Corallum
flabellate, densely branching up to 7th, dichotomous with an acute angle $10-15^\circ$ in a plane.
Branchlets long ascending.

Spines subequal, arranged in 8 longitudinal rows and usually 2-3 spines/mm in each row. Their
shape gradually slender according to increase axial diameter, 0.2-0.4 mm at distal, 0.5 mm at
middle and 0.6 mm at basal part. At basal part of branches, 0.6 mm in diameter, spines $0.12-0.17$
 $\times 0.03-0.08$ mm and their distal edge quite slender and sharp. Mutual distance at basal part
irregular, 0.25-0.60 mm and angle of spines $62-88^\circ$, sometimes facing. At middle part of
branches, 0.5 mm in diameter, spines $0.15-0.16 \times 0.10-0.11$ mm and increased in width. Mutual
distance at middle part regular, 0.32-0.45 mm and angle of spines $65-87^\circ$, sometimes bifurcated.

Table 1. Comparison of characteristics in relation to *Antipathes densa*.

Characteristics \ Parts	Basal	Middle	Distal
Diameter of branch (mm)	0.6	0.5	0.2-0.4
Shape of spines	slender and sharp	bifurcate	obtuse and bifurcate
Arrangement of spines	8 rows	8 rows	8 rows
Size of spine (mm) (length $\times$ width)	$0.12-0.17$ $\times 0.03-0.08$	$0.15-0.16$ $\times 0.10-0.11$	$0.11-0.16$ $\times 0.10-0.13$
Mutual distance of spines (mm)	0.25-0.60	0.32-0.45	0.31-0.45
Angle of spines	$62-88^\circ$	$65-87^\circ$	$75-80^\circ$
Arrangement of polyps	opposite	twist up	single row
Interpolypar distance (mm)	0.2-0.3	0.1-0.2	0.2-0.4
Size of polyps (mm)	1.8-2.0	1.7-2.0	1.2-1.5
Number of polyps/cm	6	6	6-7
Length of tentacle (mm) (sagittal)	1.0-1.2	1.3-1.4	1.2-1.5
(lateral)	1.4-1.5	1.0-1.2	0.72-0.95
Diameter of oral cone (mm)	0.7-0.8	0.9-1.0	0.5

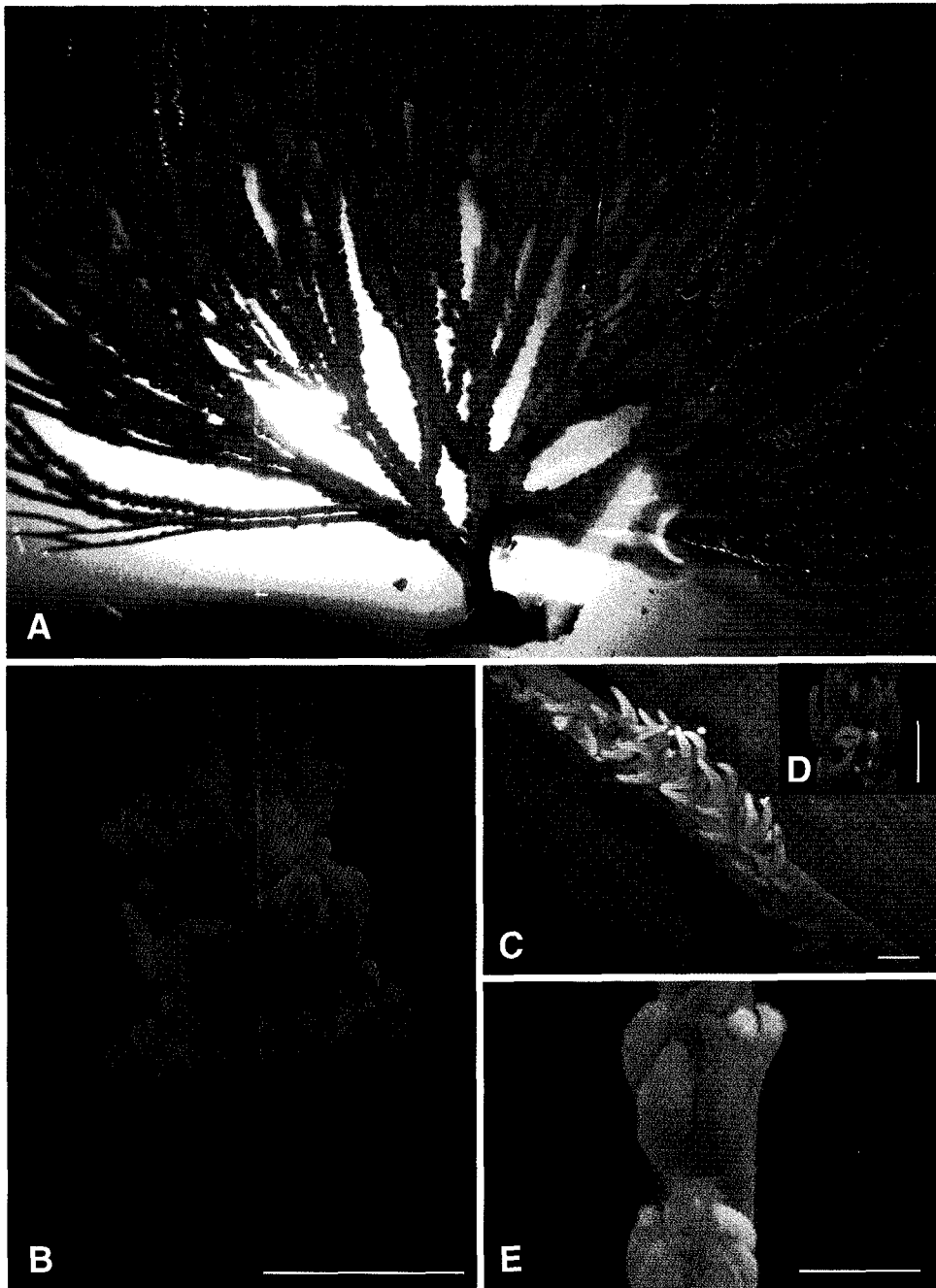


Fig. 1. *Antipathes densa*. A, corallum; B, lower part of colony showing arrangement of polyps; C, D, polyps at middle part; E, polyps at distal part. Scale bars = 3 cm (A), 1 mm (B-E).

At distal part of branches, 0.2-0.4 mm in diameter, spines $0.11-0.16 \times 0.10-0.13$ mm, blunt and bifurcated distinctly. Mutual distance at distal part regular, 0.30-0.45 mm and angle of spines 75-

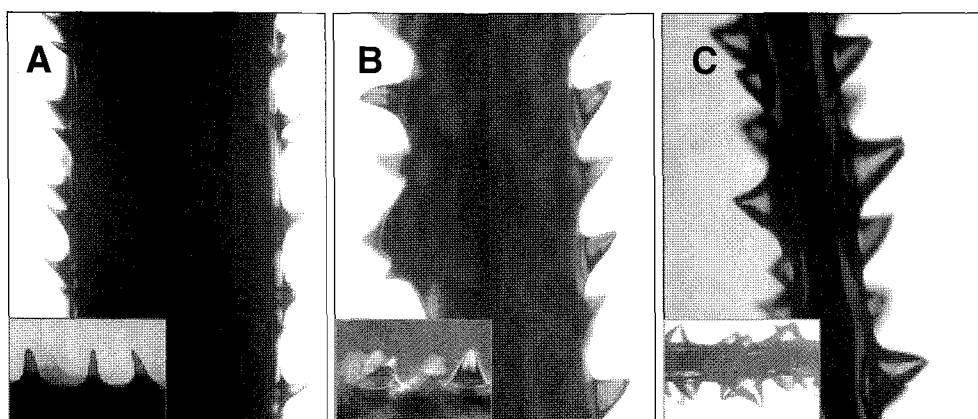


Fig. 2. Spines of *A. densa*. A, from basal part; B, from middle part; C, from distal part.

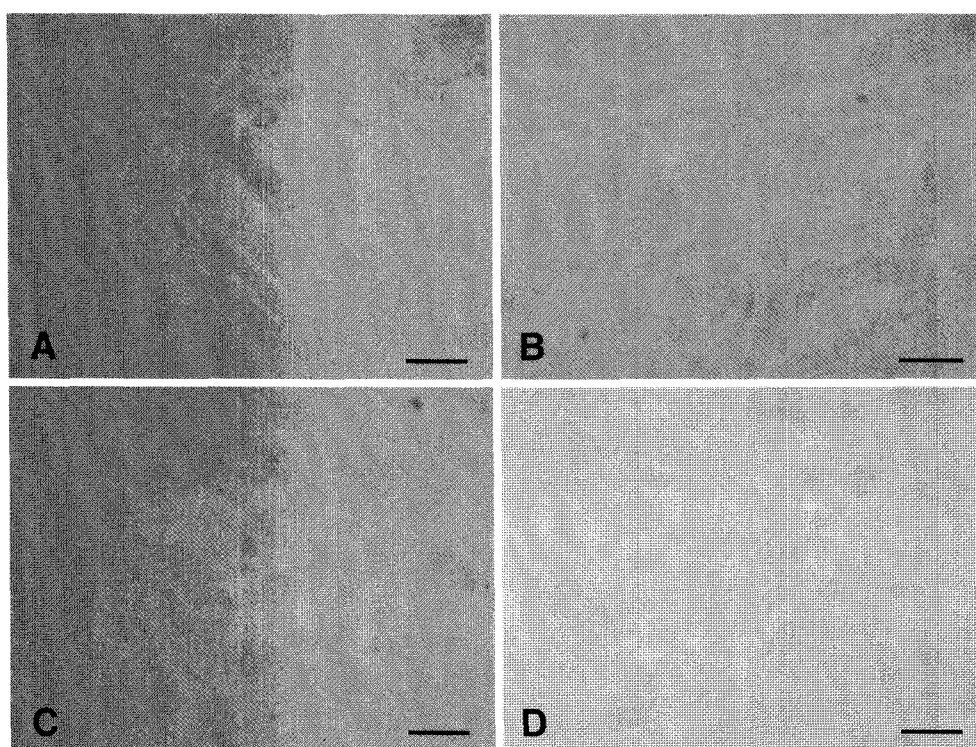


Fig. 3. Cnidae of *A. densa*. A, tentacle; B, C, oral disc; D, septal filament. Scale bars = 5 μ m.

80°.

Polyps generally arranged 6-7 polyps/cm. At basal part of branches, polyps 1.8-2.0 mm in diameter and arranged in opposition. Interpolypar distance 0.2-0.3 mm. Proximal sagittal tentacles, 1.0-1.2 $\times$ 0.40-0.44 mm. shorter than lateral ones, 1.4-1.5 $\times$ 0.40-0.55 mm. Oral

cone $0.7-0.8 \times 0.6-0.7$ mm in diameter. At middle part of branches, polyps $1.7-2.0$ mm in diameter, arranged in a single row and twist up. Distal edge of tentacles curved to twisting direction. Tentacles slender, especially sagittal tentacles, $1.3-1.4 \times 0.36-0.40$ mm, longer than lateral ones, $1.0-1.2 \times 0.45-0.50$ mm. Oral cone $0.8-0.9 \times 0.4-0.5$ mm in diameter. At distal part of branches, polyps $1.2-1.5$ mm in diameter and arranged in a single straight row. Sagittal tentacles $1.20-1.50 \times 0.40-0.55$ mm longer than lateral ones $0.72-0.95 \times 0.25-0.45$ mm. Oral cone relatively small 0.5 mm in diameter, completely covered with lateral tentacles.

Cnidae: spirocysts, basitrichs, microbasic p-mastigophores.

Distribution and size (μm) of cnidae are as follows:

Tentacle	spirocysts	13.5-17.0 $\times$ 2.3-3.0
	basitrichs	19.1-23.5 $\times$ 2.3-2.4
Oral disc	spirocysts	13.7-15.3 $\times$ 2.3-2.9
	basitrichs (rare)	19.0 $\times$ 2.3
Septal filament	microbasic p-mastigophores	18.7-22.0 $\times$ 3.1-7.0

Coloration. Axis dark brown, base storm gray and polyps light olive green.

Habitat. The colonies with various size are living at rocky substrates of subtidal zone in Jeju-do, 20-40 m deep and together with other antipatharians, *Cirripathes anguina* and *Antipathes dubia*. Some of them are associated with *Nemanthus nitidus*.

Remarks. In comparison with *A. densa* from Uraga Canal (see Silberfeld, 1909), our specimens have more number of spines in eight longitudinal rows.

Distribution. Korea (Jeju-do), Japan (Uraga Canal, Sagami Bay, Kii Peninsula 100-300 m deep).

****Antipathes grandiflora* Silberfeld, 1909 (Figs. 4-6, Table 2)**

Antipathes grandiflora Silberfeld, 1909, p. 26, fig. 5; Pesch, 1914, p. 75; Pax, 1932, p. 415, text-fig. 6; Opresko, 1974, p. 46; Okutani, 1999, p. 46, text-fig. 4; Uchida and Soyama, 2001, p. 132, text-fig. 2.

Antipathes dichotoma grandiflora: Pax, 1932, p. 420.

Material examined. 1 ind. Seogwipo, 24 Jun. 2005 (S. H. Kim), 35 m deep.

Description. Colony about 37 cm high, 30 cm wide, 12 cm thick and 1.4×0.8 cm in diameter at basal part of stem. Stem about 1.2 cm long and 0.3 cm in diameter at its base. Corallum branching up to 3rd-4th, angle of branching $60-90^\circ$ from base to $1/2$ high of corallum and then decreased, $30-60^\circ$ from $1/2$ high to distal part.

Spines subequal, arranged in 10 longitudinal rows and usually 2-3 spines/mm in each row. Their shape triangular, sometimes bifurcated and almost equal in length and width at all parts. However mutual distance regular, 0.30 mm. At basal part of branches, 0.65 mm in diameter of secondary branches, spines $0.13-0.15 \times 0.12-0.15$ mm and their shape uniform and obtuse.

Mutual distance at basal part 0.28-0.35 mm and angle of spines $61-66^\circ$, sometimes bifurcated. At middle part of 3rd branches, 0.55 mm in diameter, spines $0.11-0.14 \times 0.09-0.15$ mm and densely arranged. Mutual distance at middle part, 0.25-0.50 mm and angle of spines $57-76^\circ$. At distal part of 4th branches, 0.25 mm in diameter, spines $0.06-0.10 \times 0.05-0.09$ mm and their

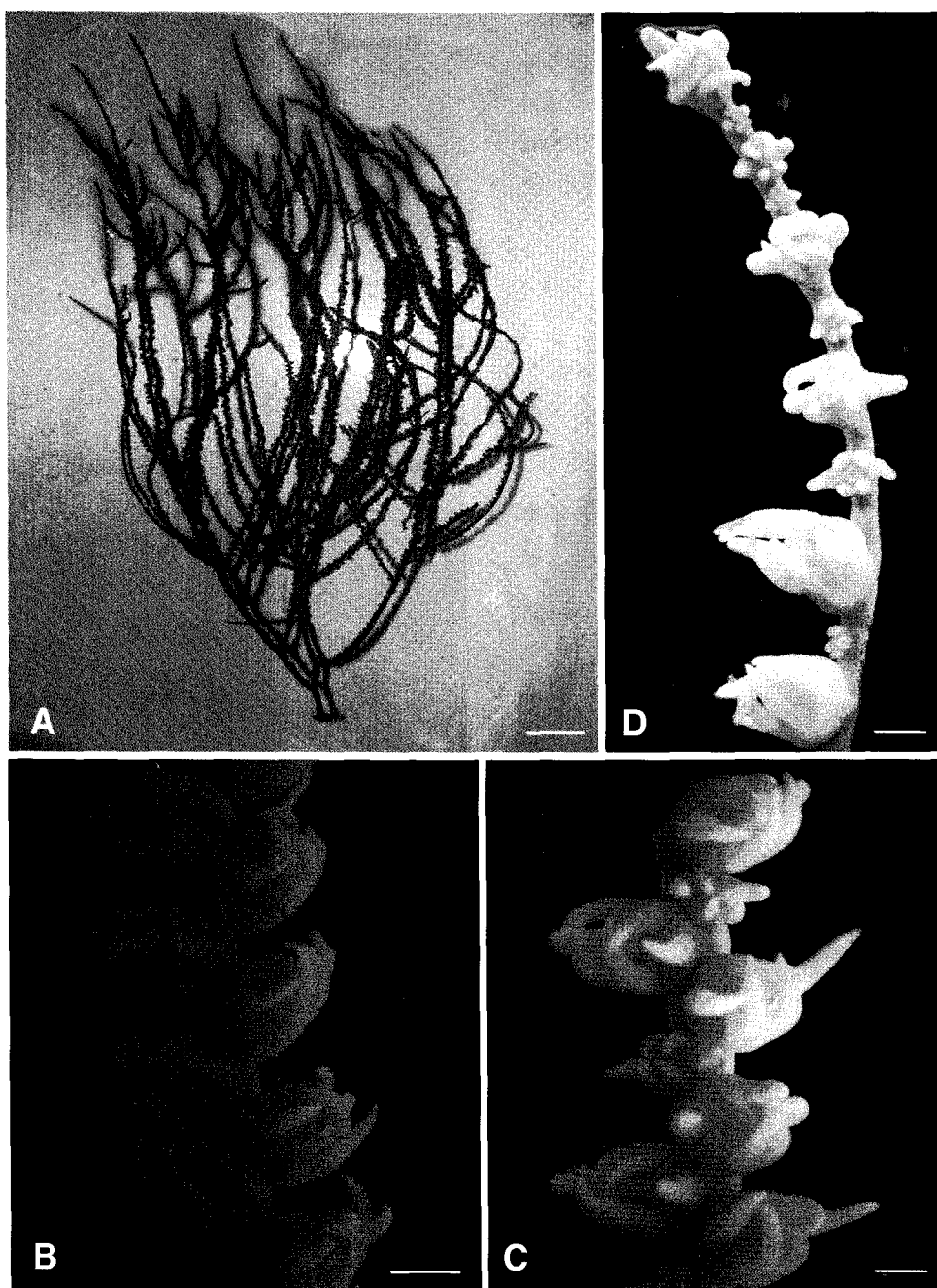


Fig. 4. *Antipathes grandiflora*. A, corallum; B, lower part of colony, showing arrangement of polyps; C, polyps at middle part; D, polyps at distal part. Scale bars = 3 cm (A), 1 mm (B-D).

terminal point acute. Mutual distance at distal part irregular, 0.20-0.45 mm and angle of spines 64-89°.

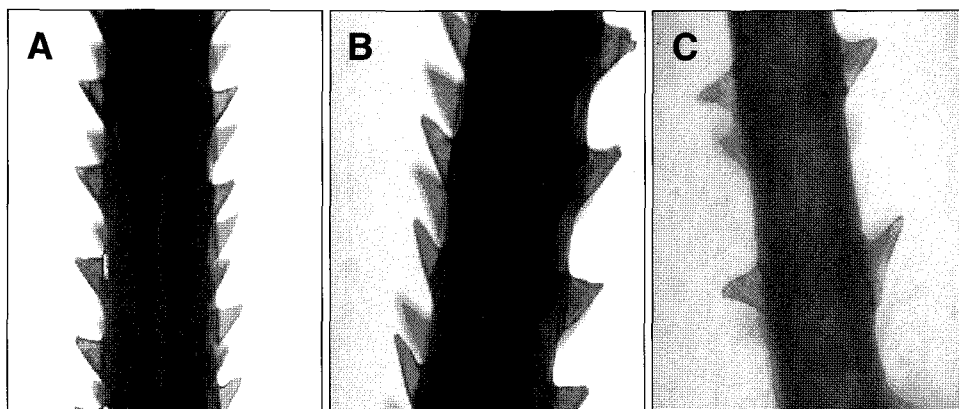


Fig. 5. Spines of *A. grandiflora*. A, from basal part; B, from middle part; C, from distal part.

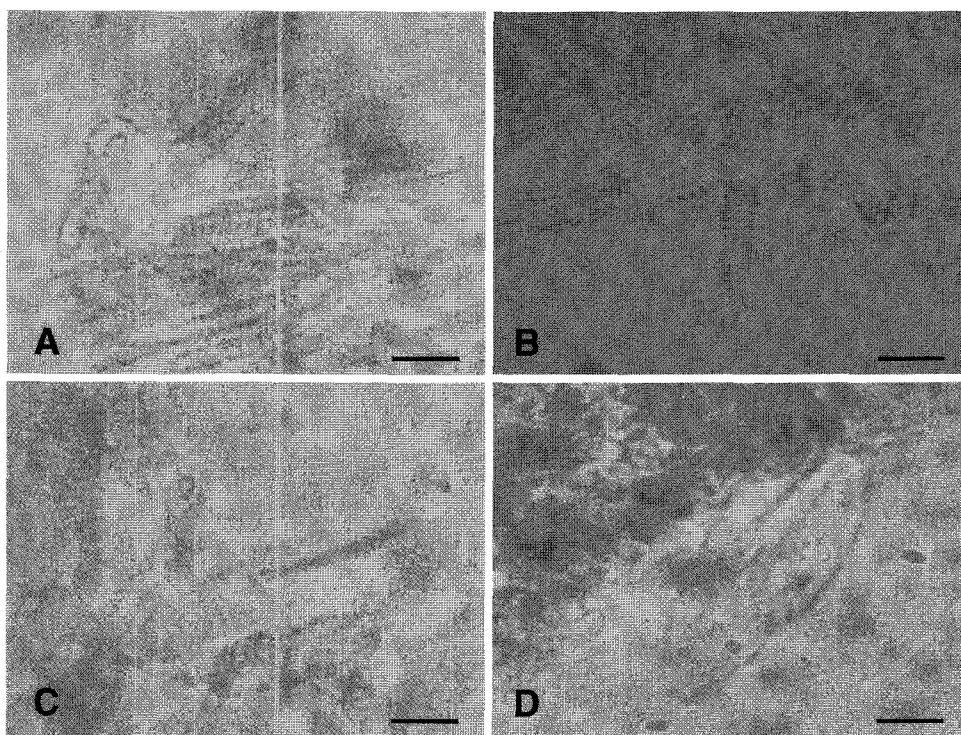


Fig. 6. Cnidae of *A. grandiflora*. A, B, tentacle; C, oral disc; D, septal filament. Scale bars = 5 μ m.

Polyps twisted along entire length of branches, arranged alternate from basal to middle part, no interpolypar distance. At secondary branches of basal part, polyps 1.2-1.5 mm in diameter, arranged 9-10 polyps/cm with similar size. Sagittal tentacles 1.8-2.0 $\times$ 0.75-0.80 mm, lateral tentacles 1.0-1.5 $\times$ 0.40-0.50 mm. Oral cone 0.55-0.60 $\times$ 0.60-0.62 in diameter. At 3rd

Table 2. Comparison of characteristics in relation to *Antipathes grandiflora*.

Characteristics \ Parts	Basal	Middle	Distal
Diameter of branch (mm)	0.65	0.55	0.25
Shape of spines	uniform and obtuse	obtuse	irregular and acute
Arrangement of spines	10 rows	10 rows	10 rows
Size of spine (mm) (length × width)	0.13-0.15 × 0.12-0.15	0.11-0.14 × 0.09-0.15	0.06-0.10 × 0.05-0.09
Mutual distance of spines (mm)	0.28-0.35	0.25-0.50	0.20-0.45
Angle of spines	61-66°	57-76°	64-89°
Arrangement of polyps	alternate and regular	alternate and regular	single row
Interpolypar distance (mm)	0	0	0.5-1.0
Size of polyps (mm)	1.2-1.5	1.0-2.0	0.5-0.8, 1.7-2.0
Number of polyps/cm	9-10	8-9	6-7
Length of tentacle (mm) (sagittal)	1.8-2.0	0.5-0.6, 1.5-2.0	0.5-0.6, 1.5-2.0
(lateral)	1.0-1.5	1.0-2.0, 2.0-2.1	1.0-1.1, 2.0-2.2
Diameter of oral cone (mm)	0.55-0.60	0.28-0.32	0.40-0.42

branches of middle part, small polyps, 1.0-1.1 mm in diameter, alternated with large ones, 1.8-2.0 mm in diameter, and arranged 8-9 polyps/cm. Sagittal tentacles 1.5-2.0 × 0.5-0.7 mm and lateral ones 1.0-2.0 × 0.4-0.5 mm with size differences. Oral cone 0.5-0.7 × 0.5-0.6 mm in diameter, covered with tentacles. At 4th branches of distal part, polyps with two size arranged in a single row. Small polyps 0.5-0.8 mm in diameter, large ones 1.7-2.0 mm in diameter, and also regular alternated. Interpolypar distance very loose, 0.5-1.0 mm, and arranged 6-7 polyps/cm. Sagittal tentacles, 0.5-0.6 × 0.1 mm-1.5-2.0 × 0.4 mm, shorter than lateral ones, 1.0-1.1 × 0.3 mm-2.0-2.2 × 0.4 mm.

Cnidae: spirocysts, basitrichs, microbasic p-mastigophores.

Distribution and size (μm) of cnidae are as follows:

Tentacle	spirocysts	14.3-19.7 × 2.2-3.5
	basitrichs	25.3-25.4 × 2.1-3.4
Oral disc	spirocysts	13.5-14.1 × 3.0-3.2
	basitrichs	17.3-17.7 × 1.4-2.5
	microbasic p-mastigophores (very rare)	24.5 × 5.6
Septal filament	microbasic p-mastigophores	17.0-21.5 × 5.0-7.2

Coloration. Axis and base storm gray, and polyp golden maize.

Habitat. This species inhabits on the sides of rocky areas, 50-60 m deep, against the strong current.

Remarks. In comparison with *A. grandiflora* from Uraga Canal (see Silberfeld, 1909), our specimen shows the alternating pattern of polyp size and many bifurcated spines.

Distribution. Korea (Jeju-do), Japan (Uraga Canal 75 m deep).

****Antipathes dubia* (Brook, 1889) (Figs. 7-9, Table 3)**

Tylopathes ? dubia Brook, 1889, p. 138, pl. 11, fig. 15.

Antipathes dubia: Silberfeld, 1909, p. 8; Pax, 1932, p. 421; Utinomi, 1965, p. 300, text-fig. 465. Opresko, 1974, p. 48.

Antipathes dubius: Utinomi, 1976, p. 27, pl. 14, fig. 2.

Material examined. 1 ind. Munseom, 23 Apr. 2005 (H. W. Moon), 38 m deep.

Description. Colony about 27 cm high, 36 cm wide, 10 cm thick and 4.5×4.0 cm in diameter at basal part of stem, directly branching from basal part without stem. Reticulated corallum flabellate, irregularly branching up to 5th with 0.3×0.4 cm in mesh size by branches and pinnules. Angle of branches $35-60^\circ$ at 1st, $60-90^\circ$ at 2nd. Branchlets bilaterally arranged, spaced 0.2-0.6 cm apart. Smallest branch 3.0×0.6 mm at 5th. On outer edges of corallum, terminal branches not crowded rather than center's. Branches stretched frontal apart from 2nd-3rd branches of main plane of corallum, 60° at 1/5 to 2/5 high, and then distal branches slightly curved towards back side. Branches occasionally overlapped and anastomosed.

Spines subequal, arranged in 8 longitudinal rows and usually 3-4 spines/mm in each row. Spines on polypar side of axis slightly larger than those on abpolypar side, and showed different shape. Spines at older and thicker parts of axis bifurcated, rarely trifurcated. At middle part of branches,

Table 3. Comparison of characteristics in relation to *Antipathes dubia*.

Characteristics \ Parts	Middle	Distal	Pinnules
Diameter of branch (mm)	0.4	0.4	0.15
Shape of spines	simple and bifurcate	curved at terminal point	acute and curved
Arrangement of spines	8 rows	8 rows	8 rows
Size of spine (mm) (length $\times$ width)	0.10-0.12 $\times$ 0.06-0.08	0.09-0.12 $\times$ 0.05-0.06	0.10-0.12 $\times$ 0.05-0.06
Mutual distance of spines (mm)	0.25-0.30	0.25-0.40 (A; 0.38)	0.25-0.40
Angle of spines	$67-104^\circ$ (irregular)	$83-90^\circ$	$71-88^\circ$
Arrangement of polyps	single row	single row	single row
Interpolypar distance (mm)	0.2-0.8	1.0 (average)	0.1-0.8
Size of polyps (mm)	0.8-1.3	0.2-1.1	0.5-1.0
Number of polyps/cm	9-10	8-9	9-10
Length of tentacle (mm) (sagittal)	0.20-0.80	0.47-0.50	0.25-0.60
(lateral)	0.30-0.50	0.85-0.90	0.70-0.83
Diameter of oral cone (mm)	0.22	0.15	0.10

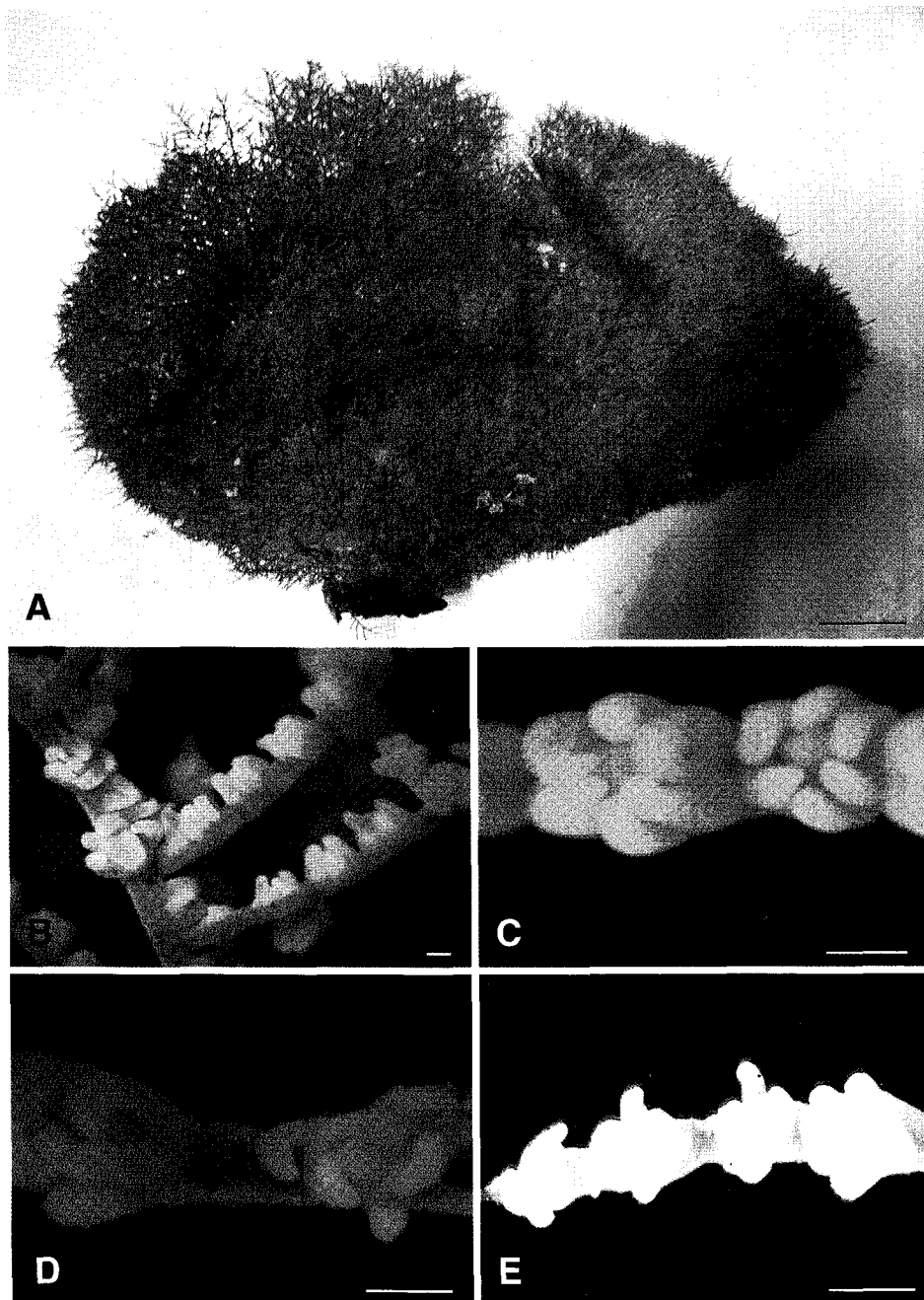


Fig. 7. *Antipathes dubia*. A, corallum; B, C, middle part of colony, showing arrangement of polyps; D, polyps at distal part; E, polyps at pinnule. Scale bars = 3 cm (A), 0.5 mm (B-E).

0.4 mm in diameter, spines $0.10\text{--}0.12 \times 0.06\text{--}0.08$ mm and with few small conical tubercles. Mutual distance at middle part 0.25–0.30 mm and in particular angle of spines irregular, $67\text{--}104^\circ$.

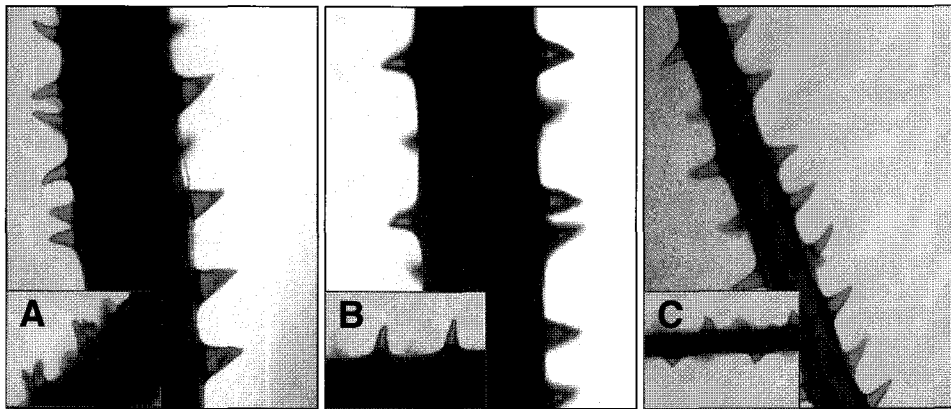


Fig. 8. Spines of *A. dubia*. A, from middle part; B, from distal part; C, from pinnule.

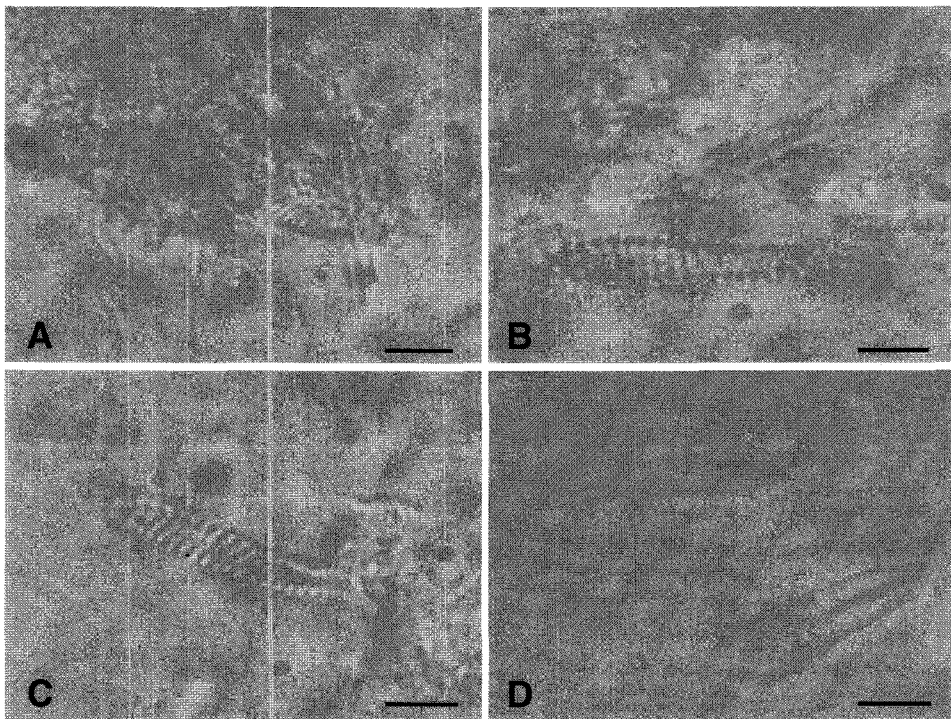


Fig. 9. Cnidae of *A. dubia*. A, B, tentacle; C, oral disc; D, septal filament. Scale bars = 5 μ m.

At distal part of branches, 0.4 mm in diameter, spines $0.09\text{--}0.12 \times 0.05\text{--}0.06$ mm and curved at terminal point. Mutual distance at distal part 0.25–0.40 mm, longer than middle part and angle of spines $83\text{--}90^\circ$. At pinnule, 0.15 mm in diameter, spines $0.10\text{--}0.12 \times 0.05\text{--}0.06$ mm and slightly acute and curved. Mutual distance of spines 0.25–0.40 mm and angle of spines $71\text{--}88^\circ$.

Polyps arranged in a single row along one side of branches at corallum, 8–10 polyps/cm.

Towards distal parts of branches, interpolyar distance increased and size of polyps decreased. Most of tentacles covered with oral disc at middle part, but irregular at distal part and pinnules. At middle part of branches, polyps 0.8–1.3 mm in diameter, densely arranged and interpolyar distance 0.2–0.8 mm. Sagittal tentacles, $0.2\text{--}0.8 \times 0.30\text{--}0.50$ mm, similar to lateral ones, $0.3\text{--}0.5 \times 0.23\text{--}0.50$ mm. Oral cone 0.22 mm in diameter. At distal part of branches, polyps 0.2–1.1 mm in diameter, interpolyar distance 1.0–1.1 mm, showing loose arrangement of polyps. Sagittal tentacles, $0.47\text{--}0.50 \times 0.25\text{--}0.30$ mm, shorter than lateral ones, $0.85\text{--}0.90 \times 0.45\text{--}0.50$ mm. Oral cone 0.15 mm in diameter. At pinnule, polyps 1.5–1.0 mm in diameter and interpolyar distance 0.1–0.8 mm, more loose than those branches. Sagittal tentacles, $0.25\text{--}0.60 \times 0.15\text{--}0.25$ mm, lateral ones, $0.70\text{--}0.83 \times 0.30\text{--}0.40$ mm. Oral cone 0.1 mm in diameter.

Cnidae: spirocysts, basitrichs, microbasic p-mastigophores.

Distribution and size (μm) of cnidae are as follows:

Tentacle	spirocysts	12.7–16.5 $\times$ 1.8–2.6
	basitrichs	15.2–21.2 $\times$ 1.9–2.7
Oral disc	spirocysts	15.4–19.4 $\times$ 2.2–2.7
Septal filament	microbasic p-mastigophores	16.9–21.5 $\times$ 4.9–6.4

Coloration. Axis black, base dark camouflage brown and polyp olive yellow.

Habitat. Several small colonies inhabit on slope side of rocky area, below 10 degrees, at 38 m deep. Organisms such as bryzoans and polychaetes are usually attached to the colonies because of the branching form.

Remarks. In comparison with *A. dubia* from Japan (see Pax, 1932), our specimen is similar in most of features except for the angle of spines $67\text{--}104^\circ$ at basal part.

Distribution. Korea (Jeju-do), Japan (Sagami Bay, Kii Peninsula 40–100 m deep, Inoshima Island).

ACKNOWLEDGMENTS

This work was supported by the Korea Research Foundation Grant (KRF-2002-070-C00089) and partly supported by Eco-Technopia 21 Project, KREST (No. 2002-05002-0007-0).

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RECEIVED: 4 October 2005

ACCEPTED: 27 October 2005

한국산 각산호류 (산호충강: 꽃말미잘아강)의 3미기록종

문 혜 원 · 송 준 임*

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요 약

한국산 해송류는 1과 2속 3종이 보고되어 있으며, 본 연구에서는 2003년부터 2005년까지 제주도에서 채집된 해송류로부터 3종인 빗자루해송 (*Antipathes densa*), 큰꽃해송 (*A. grandiflora*) 및 망해송 (*A. dubia*)이 새로운 한국 미기록종으로 보고 된다. 이들은 주로 생태, 산호체의 분지양상, 폴립과 가시의 크기와 배열 및 자포형에 근거를 두고 기재를 하였다. 3종류의 자포형인 spirocysts, basitrichs, microbasic p-mastigophores를 지니고 있었으며, spirocysts와 basitrichs는 측수에 분포하였고, microbasic p-mastigophores는 주로 격막사에 존재하였다.